An electron microscope study of the effects of decompression on the spinal cord and hippocampus in the rat: preliminary results.

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Introduction

- There are a number of reports on the vulnerability of the spinal cord to decompression stress (Sykes & Yaffe, 1985; Mørk et al., 1994).
- Examination of spinal cord axons after exposure to decompression revealed “dramatic changes in the ultrastructural appearance of the myelin sheaths …..” (Sykes & Yaffe, 1985).
- In humans, diving activity or saturation diving was not found to “lead to necrosis, degeneration, or scar formation in the human spinal cord” (Mørk et al., 1994).
- Less is known on the effect of decompression on other regions of the brain, such as the hippocampus.

Purpose of the Study

- To compare the effect of decompression from 8 or 10 ATA (bottom time 30 min) on the cellular structure of the hippocampus and the spinal cord.

Methods

- Ten male Sprague-Dawley rats (3 control, 7 experimental) weighing about 300 g were exposed to different dive protocols (no pressure, 8 ATA, 10 ATA, for 30 min).
- Following decompression, animals were anesthetized. Perfusion fixation was performed through the heart with paraformaldehyde 4%.

Methods (cont'd)

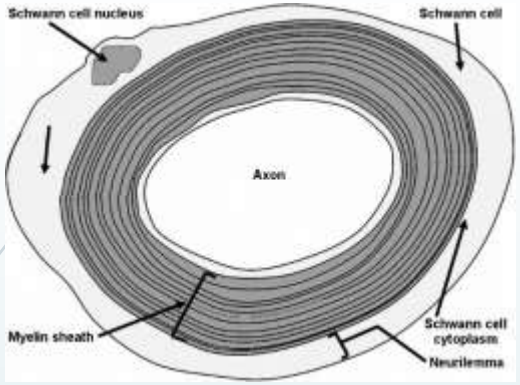
- The hippocampus and spinal cord were removed for electron microscope evaluation.
- Slides were analyzed with a magnification of 5,000 – 10,000.
- Myelinated axons were defined as small (≤2 μm) or large (>2 μm).
- Each axon was scored according to the level of conservation of the myelin architecture (normal, moderate, poor).

Results

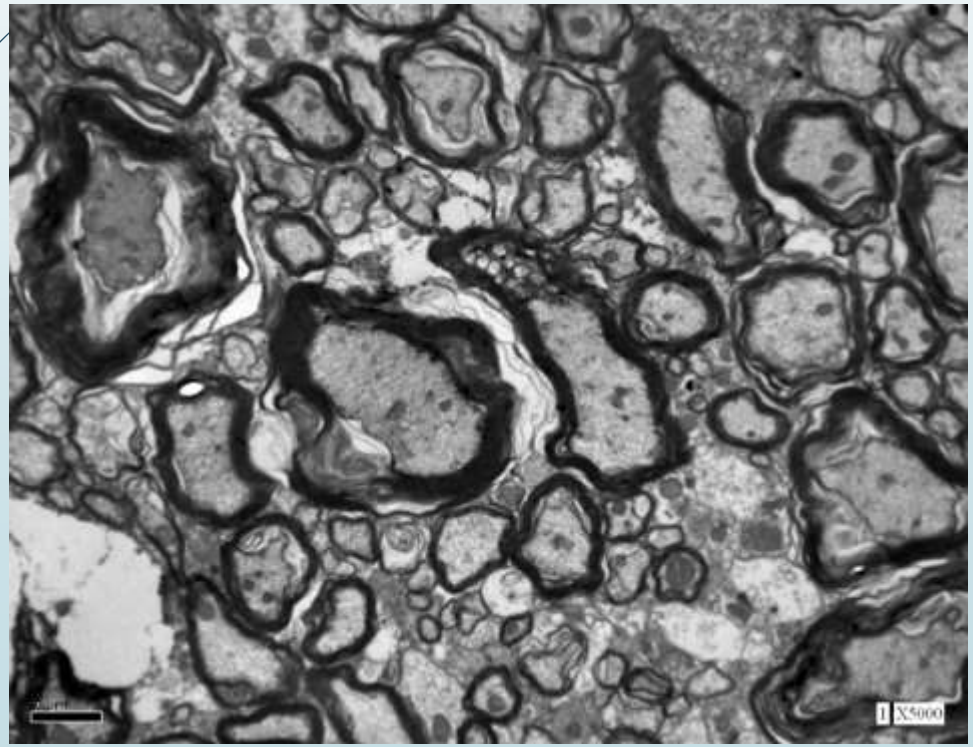
	Spinal Cord		Hippocampus	
	Large	Small	Large	Small
Control	103 (31%)	208 (69%)	0	179 (100%)
Decompression	113 (18%)	521 (82%)	3 (1%)	594 (99%)

Large >2 μm; Small ≤2 μm.

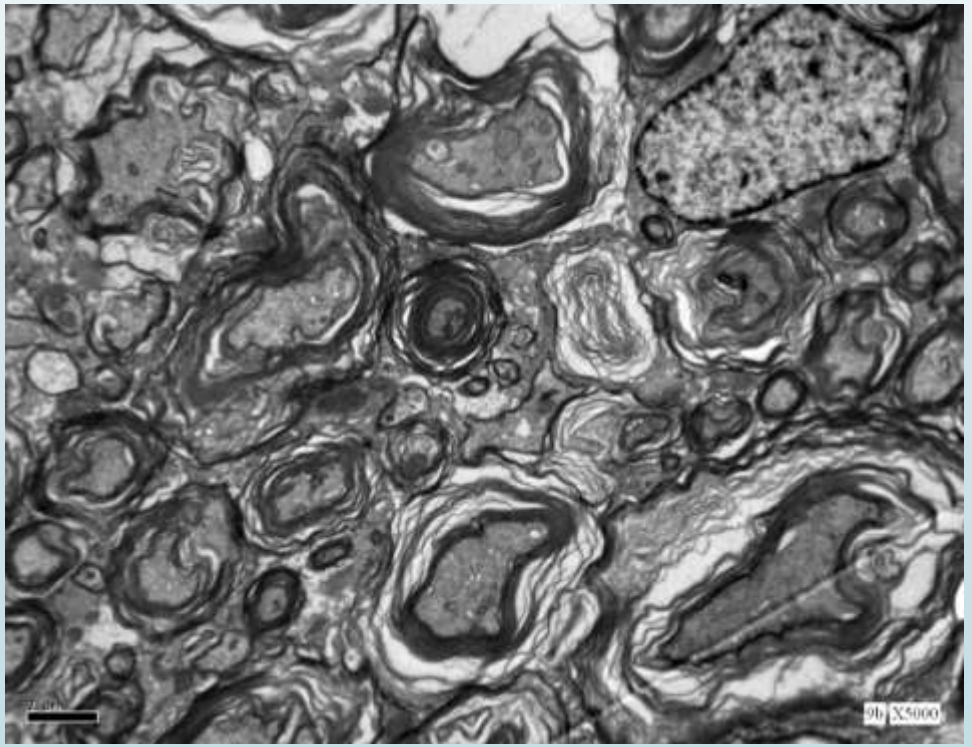
Decompression Effect on Myelinated Spinal Cord Axons



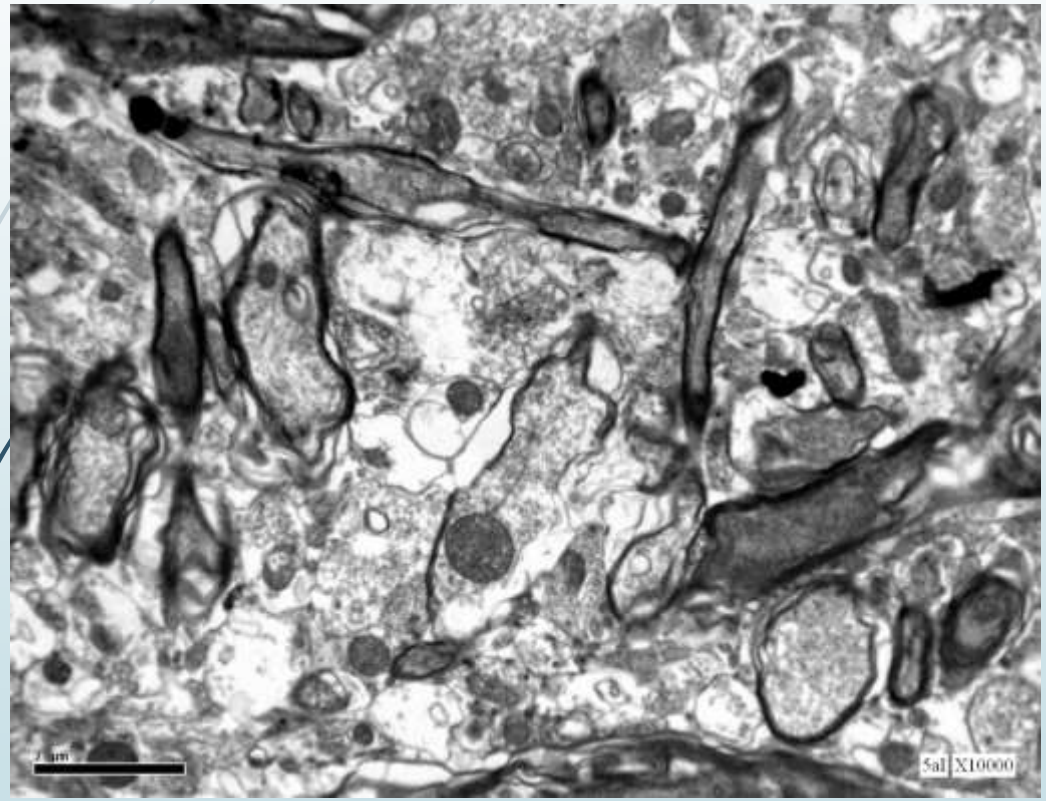
Control

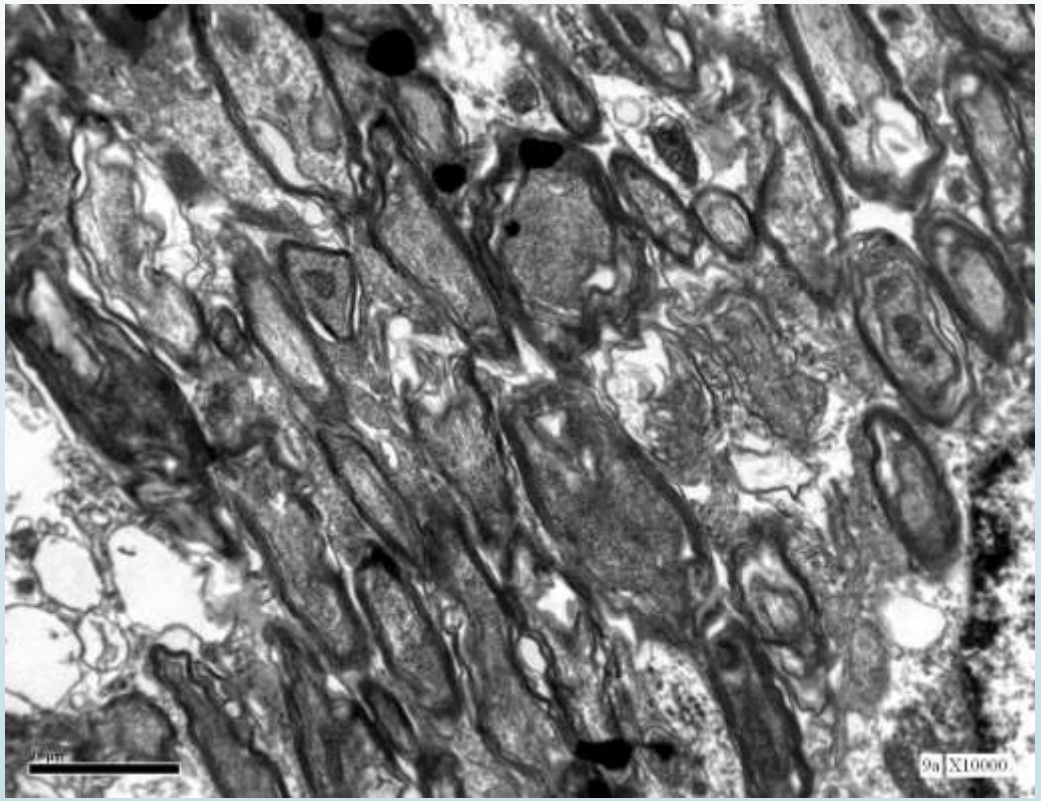


Decompression

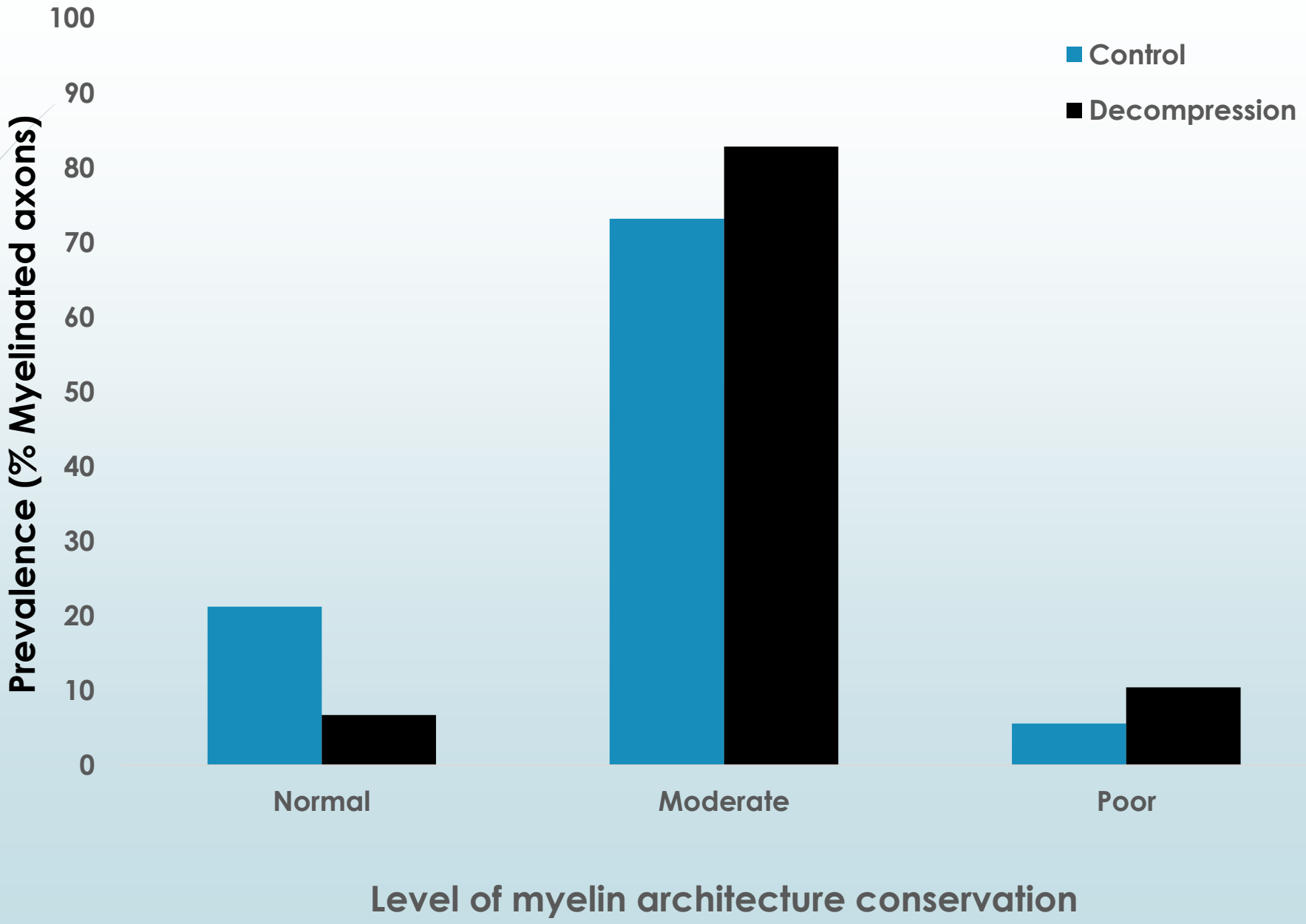


Decompression Effect on Myelinated Hippocampus Axons

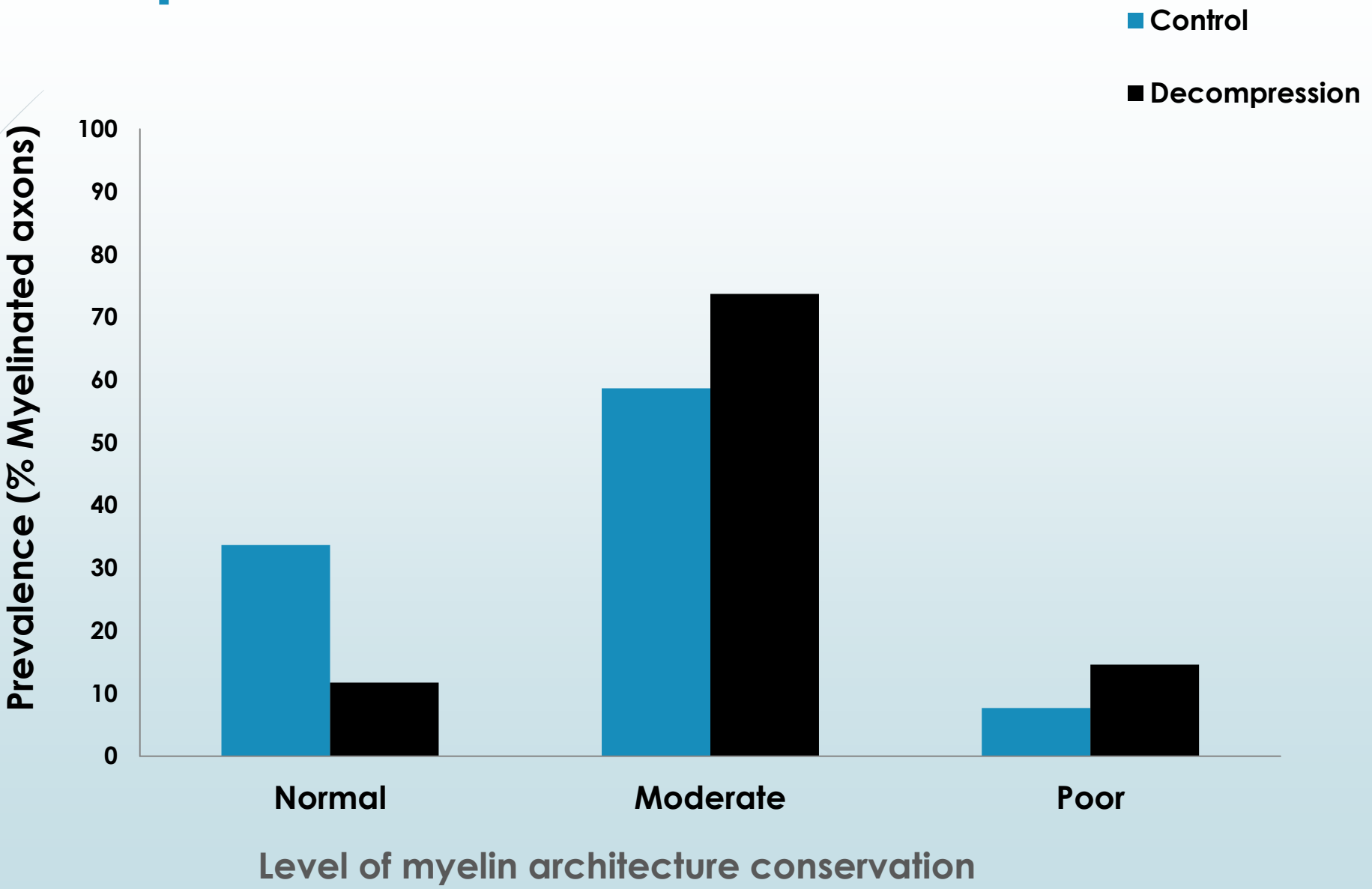




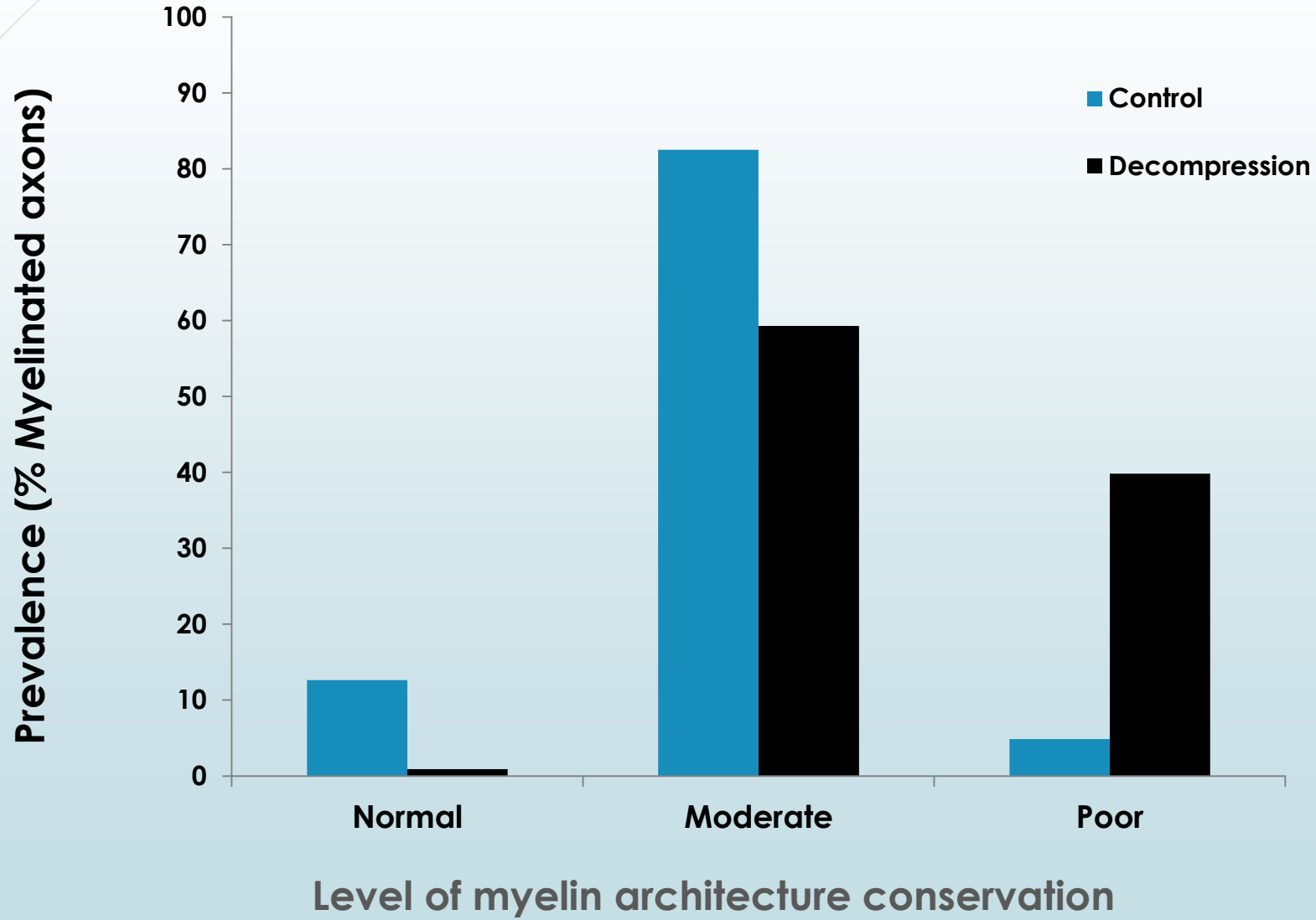
Hippocampus – Small Axons



Spinal Cord – Small Axons



Spinal Cord – Large Axons



Conclusions

- These preliminary results suggest that myelin, due to its unique structure, is a major site for decompression-induced destruction.
- These structural changes may involved severe spinal cord decompression symptoms.
- The myelin structure was more vulnerable in axons having a diameter greater than 2 μm.
- Larger axons with a corresponding volume of myelin (80% fat) may attract nitrogen during pressure exposure.
- The hippocampus may be partially protected against major structural changes in myelinated neuron cells due to its having only small axons.